UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

CARNEGIE INSTITUTION OF WASHINGTON, M7D CORPORATION, *Plaintiffs*, v. PURE GROWN DIAMONDS, INC. and IIA TECHNOLOGIES PTE. LTD d/b/a IIA TECHNOLOGIES, *Defendants*. PURE GROWN DIAMONDS, INC., *Counterclaim-Plaintiff*, v. CARNEGIE INSTITUTION OF WASHINGTON, M7D CORPORATION, *Counterclaim-Defendants*.	Civil Action No. 1:20-cv-00189-JSR

PLAINTIFFS' STATEMENT OF MATERIAL FACTS IN SUPPORT OF THEIR OPPOSITION TO DEFENDANTS' MOTION FOR SUMMARY JUDGMENT

Pursuant to Local Civil Rule 56.1(a), Plaintiffs Carnegie Institution of Washington ("Carnegie") and M7D Corporation ("M7D") (collectively, "Plaintiffs") respectfully submit this Statement of Material Facts in support of their Opposition to Defendants' Motion for Summary Judgment.

I. BACKGROUND

1. U.S. Patent No. 6,858,078 ("'078 patent") and U.S. Patent No. RE41,189 ("'189 patent") disclose methods for producing laboratory-grown diamonds. ECF Nos. 97-1, 97-38.

2. Methods for producing laboratory-grown diamonds include high-pressure, high-temperature ("HPHT") and chemical vapor deposition ("CVD"). *See* Ex.[1] 1 (Expert Report of Michael Capano, Ph.D. Regarding Infringement of U.S. Patent Nos. 6,858,078 and RE41, 189 ("Capano")) ¶¶ 77, 81.

3. Microwave plasma CVD ("MPCVD") relies on process controls that manipulate temperature, pressure, and gas-phase chemistry to grow high-quality diamonds. *See* Ex. 4 (Hemley 9/1/20 Dep.) at 75:18-76:16.

4. CVD diamonds are grown in a deposition chamber where air is removed and electrodes generate a plasma used to perform chemical vapor deposition. ECF No. 97-1 ('078 patent) at 4:12-21; Ex. 2 (Expert Report of Karen K. Gleason, Ph.D. Regarding Validity of U.S. Patent No. 6,858,078 ("Gleason '078")) ¶ 58; Ex. 1 (Capano) ¶ 64.

5. A diamond "seed" is placed in the chamber. ECF No. 97-1 ('078 patent) at 3:65-4:21; 4:56-67; Ex. 2 (Gleason '078) ¶ 58; Ex. 1 (Capano) ¶ 64.

6. Gases are pumped into the chamber and microwave power is applied, igniting the plasma. Ex. 2 (Gleason '078) ¶ 58; Ex. 1 (Capano) ¶ 64.

[1] Exhibits 1 through 47 are attached to the Declaration of Matthew J. Moffa concurrently filed herewith.

7. Pressure and microwave power are then incrementally increased until growth conditions are reached. Ex. 2 (Gleason ’078) ¶ 58; Ex. 1 (Capano) ¶ 64.

8. The properties of these laboratory grown diamonds depend on these types of manufacturing process details. Ex. 1 (Capano) ¶¶ 83, 93, 95.

9. Lab-grown diamonds may have a single crystal (monocrystalline) or may include many crystals (polycrystalline). Ex. 1 (Capano) ¶¶ 86, 96-100.

10. Monocrystalline diamonds are commonly used as gemstones, while polycrystalline diamonds are typically used in industrial applications. Ex. 1 (Capano) ¶ 101.

A. U.S. Patent No. 6,858,078

11. CVD methods that could produce “small quantities of diamond” were known in the art, but the known processes resulted in slow growth rates. ECF No. 97-1 (’078 patent) at 1:30-51; Ex. 2 (Gleason ’078) ¶ 56; Ex. 1 (Capano) ¶ 62.

12. Attempts to grow single-crystal diamond at higher rates were unsuccessful, resulting in, e.g., diamonds that were polycrystalline, had significant defects or stresses. ECF No. 97-1 (’078 patent) at 1:52-61; Ex. 2 (Gleason ’078) ¶ 56; Ex. 1 (Capano) ¶ 62.

13. The ’078 patent’s inventors—researchers at the Carnegie Institution of Washington—developed an approach enabling faster growth of substantially single-crystal diamonds (albeit, with a small degree of polycrystallinity). ECF No. 97-1 (’078 patent) at 13:38-14:7; Ex. 2 (Gleason ’078) ¶ 57; Ex. 1 (Capano) ¶ 63.

14. The ’078 patent discloses ensuring the growth of high-quality, single crystal diamonds by controlling the growth surface temperatures and growth surface temperature gradients. ECF No. 97-1 (’078 patent) at 6:51-54; Ex. 2 (Gleason ’078) ¶ 59; Ex. 1 (Capano) ¶ 65.

15. The ’078 patent teaches that the temperature of the growth surface of the diamond should be controlled so that all temperature gradients (difference) across the growth surface are less than 20 °C. *See, e.g.*, ECF No. 97-1 (’078 patent) at Claim 1 (“controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20 °C”), Abstract (“controlling temperature of the growth surface such that all temperature gradients across the growth surface are less than 20 °C”), 2:66-3:5 (“a method for producing diamond includes controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20 °C and growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface”), 3:8-13 (same); *see also* Ex. 2 (Gleason ’078) ¶¶ 59-61; Ex. 1 (Capano) ¶¶ 65-68.

16. The ’078 patent explains various parameters for establishing, applying, and adjusting control parameters to ensure the claimed temperature “gradients.” *See, e.g.*, ECF No. 97-1 (’078 patent) at 4:59-64, 6:17-25, 12:21-46; Ex. 2 (Gleason ’078) ¶¶ 61-62.

> The ability to control all of the temperature gradients across the growth surface of the diamond **136** is influenced by several factors, including the heat sinking capability of the stage **124**, the positioning of the top surface of the diamond in the plasma **141**, the uniformity of the plasma **141** that the growth surface of the diamond is subjected to, the quality of thermal transfer from edges of the diamond via the holder or sheath **134** to the stage **124**, the controllability of the microwave power, coolant flow rate, coolant temperature, gas flow rates, reactant flow rate and the detection capabilities of the infrared pyrometer **142**.

ECF No. 97-1 (’078 patent) at 6:55-66; Ex. 2 (Gleason ’078) ¶¶ 61-62.

17. By using these parameters to control the temperature of a growth surface, the inventors developed a system that could be used with larger seeds while reducing defects, e.g., polycrystallinity and “twinning.” Ex. 2 (Gleason ’078) ¶ 63; ECF No. 97-1 (’078 patent) at 13:21-14:63.

18. This allowed the inventors to grow larger single crystal diamond and "large, high quality diamonds with increased growth rates." ECF No. 97-1 ('078 patent) at 13:21-22; Ex. 2 (Gleason '078) ¶ 63.

19. The '078 patent describes various configurations for use in the claimed methods. For example, some systems use a holder that makes thermal contact with a side surface of the diamond. Ex. 2 (Gleason '078) ¶¶ 88, 138-44, 149-50.

20. Others use a simple holder, such as a flat plate. Ex. 2 (Gleason '078) ¶¶ 88, 138-44, 149-50.

21. The '078 patent issued on February 22, 2005, to Russell J. Hemley, Ho-kwang Mao, Chih-shiue Yan and Yogesh K. Vohra. ECF No. 97-1 ('078 patent) at [75].

22. The patent contains 64 claims, six of which are asserted in the present litigation (claims 1, 6, 11, 12, 16, and 20). ECF No. 97-1 ('078 patent); Ex. 2 (Gleason '078) ¶ 3.

23. The asserted independent claims 1 and 12 of the '078 patent recite:

1. A method for diamond production, comprising: controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface at a growth temperature in a deposition chamber having an atmosphere with a pressure of at least 130 torr.	**12.** A method for diamond production, comprising: controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.; and growing single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface at a temperature of 900–1400° C.

ECF No. 97-1 ('078 patent) at 14:64-15:4, 15:31-37.

B. U.S. Patent No. RE41,189

24. Laboratory-grown diamonds can have flaws limiting their use. ECF No. 97-38 ('189 patent) at 1:14-21, 2:7-9; Ex. 3 (Expert Report of Karen K. Gleason, Ph.D. Regarding

Validity of U.S. Patent No. RE41,189 ("Gleason '189")) ¶ 65; Ex. 1 (Capano) ¶¶ 352-53. These flaws may lead to single-crystal and polycrystalline CVD diamonds that "range from opaque to fully transparent," even being "very dark" and "opaque to optical transmission." ECF No. 97-38 ('189 patent) at 1:12-21, 3:19-21; Ex. 3 (Gleason '189) ¶ 65; Ex. 1 (Capano) ¶ 352.

25. While diamond suppliers attempted to improve natural and HPHT diamond properties with "annealing" processes, these processes often resulted in cracks, darkening, and even converting the diamond to graphite. ECF No. 97-38 ('189 patent) at 1:26-32, 2:29-44; Ex. 3 (Gleason '189) ¶ 65; Ex. 1 (Capano) ¶ 353.

26. The '189 patent describes methods of improving the optical clarity of *single-crystal CVD* diamond (as opposed to natural and HPHT diamond) by subjecting it to HPHT annealing conditions, i.e., certain minimum temperatures and pressures. Applying high pressures and temperatures results in a more perfect diamond crystalline material, (ECF No. 97-38 ('189 patent) at 2:29-50; Ex. 3 (Gleason '189) ¶ 66; Ex. 1 (Capano) ¶¶ 354-56), and improves the diamond's optical, electrical, thermal, and mechanical properties, increasing its value. ECF No. 97-38 ('189 patent) at 1:10-12, 1:43-45, 1:61-65, 1:67-2:3, 2:29-34; Ex. 3 (Gleason '189) ¶ 66; Ex. 1 (Capano ¶¶ 354-56)

27. The '189 patent is a reissue of U.S. Patent 6,811,610 ("the '610 patent"), filed on June 3, 2002, and issued on November 2, 2004. ECF No. 97-38 ('189 patent) at [64]. The '189 patent, in turn, issued on April 6, 2010, to Wei Li, Russell J. Hemley, Ho-kwang Mao, and Chih-shiue Yan. *Id*. at cover.

28. The '189 patent's independent claim 1 recites a method "to improve the optical clarity of CVD diamond where the CVD diamond is single crystal CVD diamond, by raising the

CVD diamond to a set temperature of at least 1500° C. and a pressure of at least 4.0 GPA outside of the diamond stable phase." ECF No. 97-38 ('189 patent) at 4:10-14.

C. The Present Litigation and the Court's Claim Constructions

29. PGD sells laboratory grown diamonds manufactured by 2A. ECF No. 47 (Answer) ¶¶ 18-28; Ex. 16 (Carnegie_189_PGD-00008957-975) at 962.

30. In January 2020, Plaintiffs filed suit, alleging willful infringement of the '078 patent and the '189 patent through the manufacture, sale, and importation of diamonds made using the patented processes. *See* ECF No. 1.

31. After the Court entered a schedule, ECF No. 26, the parties filed competing *Markman* submissions disputing, among other things, the meaning of the terms "single-crystal diamond" in the '078 patent and "single crystal CVD diamond" in the '189 patent. *See* ECF No. 27-1 (Joint Claim Construction Statement) at 3.

32. On May 8, 2020, the Court issued its *Markman* order, construing these terms to mean "a stand alone diamond [made by chemical vapor deposition] having insubstantial non-monocrystalline growth." ECF No. 46 (Opinion and Order) at 27-29.

33. In reaching this construction, the Court acknowledged that a stand-alone diamond remains "single crystal" even if containing "small and localized amounts of polycrystallinity or other impurities." ECF No. 46 (Opinion and Order) at 28.

34. On September 18, 2020, Plaintiffs offered opening expert reports, including the report of Dr. Michael Capano in support of infringement of the asserted patents ("Capano Report"). Ex. 1 (Capano) cover page, signature page.

35. On October 9, 2020, Plaintiffs offered rebuttal reports, including the reports of Dr. Karen Gleason regarding the validity of the '078 patent (Ex. 2 (Gleason '078), cover page, signature page), and the '189 patent (Ex. 3 (Gleason '189), cover page, signature page).

II. ARGUMENT

A. Infringement of the Asserted Claims of the ’078 Patent Is Disputed.

1. Whether IIA manufactures “single crystal diamond” is disputed.

36. In a December 12, 2014 press release, 2A’s CEO Vishal Mehta was quoted as saying that Defendants manufacture and sell “gem quality, near colorless diamonds of significant carat size.” *See* Ex. 17 (CARN-PGD_00000274) at CARN-PGD_00000281. That same press release notes that the name “2A” is derived from the term for “the purest and rarest diamonds” and states that Defendants’ diamonds are “indistinguishable from mined diamonds, even under a microscope.” *Id*. at CARN-PGD_00000274, CARN-PGD_00000281.

37. Dr. Misra testified that 2A manufactures single crystal diamonds:

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

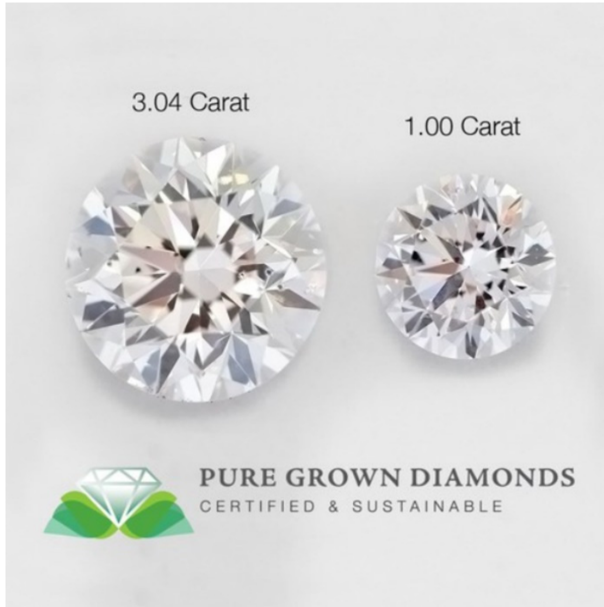
[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

38. A photo of one of IIA’s diamonds is shown on the left in the image below.



Ex. 17 (CARN-PGD_00000274) at CARN-PGD_00000275.

39. 2A is PGD's exclusive supplier for lab-grown diamonds. *Id.* at CARN-PGD_00000279 ("Pure Grown Diamonds are cultivated at its Singapore sister company IIA Technologies' state of the art facilities…").

40. Whether natural or laboratory-grown, no diamond is perfectly pure. Every diamond has some inclusions or blemishes. For example, diamonds may have some degree of polycrystallinity, which occurs when a diamond forms in multiple distinct "grains," each one with its own crystalline orientation. Some may have inclusions, which can include graphite or other forms of carbon, or can even include flaws due to debris from the growth chamber. Ex. 1 (Capano) ¶¶ 96, 99, 110, 116.

41. The '078 patent teaches that controlling the temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C results in substantially single-crystal diamonds, i.e., with only "a small degree of polycrystallinity." ECF No. 97-1 ('078 patent) at Abstract, 13:66-14:1.

42. In 2002, a paper by the named inventors of the ’078 patent Chih-shiue Yan, Yogesh Vohra, Ho-kwang Mao, and Russell Hemley described a diamond where “considerable spherical diamond-like carbon exists on the edge and corner…. After polishing off the small amount of black diamond-like carbon, which broadens the XRD peak width, our CVD diamond is a single crystal.” ECF No. 97-3 at 12524.

43. During claim construction, Plaintiffs and IIA offered constructions for the term “single-crystal diamond” that allowed for some degree of polycrystallinity. *See* ECF No. 27-1 (Joint Claim Construction Statement) at 3; *see also* ECF No. 46 (Opinion and Order) at 28 (“The parties agree that a ‘single-crystal’ diamond is a stand-alone diamond that has a primarily single-crystal, as opposed to polycrystalline, structure. They also agree that a diamond can still be deemed single-crystal even if it contains small and localized amounts of polycrystallinity or other impurities, such as graphite, twinned diamond, or diamond-like carbon, in its atomic structure.”).

44. On May 8, 2020, the Court construed the terms “single-crystal diamond” (in the ’078 patent) and “single crystal CVD diamond” (in the ’189 patent) to mean “a stand alone diamond [made by chemical vapor deposition] having insubstantial non-monocrystalline growth,” acknowledging that a stand-alone diamond remains “single crystal” even if containing “small and localized amounts of polycrystallinity or other impurities.” ECF No. 46 (Opinion and Order) at 27-29.

45. Researchers in the field use experimental techniques known as “X-Ray Diffraction” (“XRD”) and “rocking curve analysis” in order to determine whether a diamond is single crystal. Ex. 1 (Capano) ¶ 88 (“X-ray diffraction is an ideal tool for confirming the existence of a single crystal and characterization its degree of perfection”); *id.* ¶ 237 (rocking

curve analysis is used "to assess the quality of the crystal"); Ex. 18 (Vohra) at 80:1-83:5; Ex. 4 (Hemley 9/2/20 Dep.) at 262:22-25.

46. Plaintiffs' infringement expert Dr. Michael Capano, Ph.D. performed a series of experiments [redacted] Dr. Capano's tests included [redacted]

47. Dr. Capano applied the Court's construction of the terms "single-crystal diamond" and "single crystal CVD diamond" when conducting his analysis. Ex. 1 (Capano) ¶¶ 226-27.

48. Dr. Capano explained that "it is impossible to grow a defect free single crystal using MPCVD" and agreed that "the Court's construction captures this well-known concept by acknowledging that it may have 'insubstantial non-monocrystalline growth.'" Ex. 1 (Capano) ¶ 226. Dr. Capano also explained that under to the Court's construction, "a single crystal material is a material where the crystal lattice is continuous and unbroken to the edges with no grain boundaries." *Id.*

49. Dr. Capano's characterization of single-crystal material is consistent with how IIA characterized single crystal/monocrystalline in its Opening *Markman* brief. *Id.*; *see also* ECF No. 32 (*Markman* Br.) at 11 ("A single-crystal, or monocrystalline, solid is a material in which the crystal lattice of the entire sample is continuous and unbroken to the edges of the sample, with no grain boundaries.").

50. Dr. Capano's experiments "confirm[ed] the [redacted]" Ex. 1 (Capano) ¶ 231.

51. In Defendants' process, [redacted]

52. When the growth process is done, [redacted] and then further cut and polished such that the resulting diamond can be made into jewelry. *Id.*

53. Dr. Misra explained that [redacted] Ex. 7 (Misra 8/6/20 Dep.) at 25:8-26:7.

54. Dr. Capano explained that "it is commonly known in the industry that non-diamond carbon is an [sic] expected to form over the diamond and its holder during the diamond growth process. Its occurrence does not change the fact that the crystalline structure below is single crystal diamond. Moreover, it is expected that non-diamond carbon will also form at the sides, edges and corners of diamond seeds during the diamond growth process. Its occurrence does not change the fact that the a MPCVD-grown diamond can have the crystalline structure of a 'single crystal' diamond even though 'it is embedded in a polycrystalline diamond' during the growth process." Ex. 1 (Capano) ¶ 174.

55. Defendants' witnesses testified that [redacted]

[redacted]

56. Dr. Misra testified that [redacted]. *See* Ex. 7 (Misra 8/6/20 Dep.) at 41:1-42:10; *see also id*. at 77:12-24, 128:19-129:2.

57. Dr. Nebel testified that when growing multiple diamonds, some diamonds have fewer defects than others. Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 12:14-22.

58. Dr. Nebel did not see any of the stones that are depicted in Exhibit 24 to Defendants' opening brief in person, and he does not know how those photos were taken or what the contrast settings on the equipment were. Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 51:14-19, 53:3-8.

59. Dr. Vohra testified that use of x-rays and rocking curve analysis is necessary to show whether a diamond is single-crystal. "[T]o really show that it's twin free, you really have to use x-rays and get what we call the rocking curve, which will tell you whether you have a mono crystal or if you have more than one crystal. …we have to do the rocking curve measurements by x-ray technique to show the quality of crystal. Because all of the other visual observations are really qualitative about the crystal quality.... It's really hard with just a visual inspection. I mean, you could tell from the growth steps and the surface appearance. But eventually, you know, to check the crystalline quality, you have to put it on the x-ray machine and tilt it to show that there's only one grain of diamond. That's the key." Ex. 18 (Vohra) at 80:1-83:5.

60. Dr. Hemley testified that XRD can show "very clearly" if a diamond is "essentially all one single crystal." *See* Ex. 4 (Hemley 9/2/20 Dep.) at 262:21-25 ("[T]he x-ray diffraction shows that a deposited diamond is essentially all one single crystal. You see that very clearly in the x-ray diffraction. The specific diffraction.").

61. Dr. Hemley further testified that XRD is sensitive enough to detect a "very, very small amount of a carbon by volume or by mass" that is "basically not visible in the optical image." Ex. 4 (Hemley 9/2/20 Dep.) at 261:10-15.

62. Dr. Capano [redacted] Ex.1 (Capano) ¶ 237.

63. Dr. Nebel testified that he did not perform any tests on the "rough diamond block" and analyzed it by "using [his] eyes":

> **Q** Do you see the figure above paragraph 324 on your -- in your expert report which is the rough diamond block that Dr. CAP analyzed?
>
> **A** You are speaking now about paragraph 324.
>
> **Q** Right. Above 324, the rough diamond block.
>
> **A** Yes.
>
> **Q** Did you analyze the rough diamond block yourself?
>
> **A** I did analyze this by using my eyes. I looked at it.
>
> **Q** You didn't perform any tests on this rough diamond block.
>
> **A** No, I did not perform any x-ray analysis on such a block.
>
> **Q** And you didn't perform a rocking curve on the block.
>
> **A** I did not perform a rocking curvemeasurement on this.
>
> **Q** Do you have access to that type of equipment.
>
> **A** X-ray systems are all over so we have access, yes.

Ex. 6 (Nebel 10/26/20 (Rough) Dep) at 62:1-25.

2. Whether IIA "control[s] the temperature of a growth surface such that all temperature gradients are less than 20°C" is disputed.

64. Mr. Ghosh testified about the relationship [redacted]

[redacted]

65. Dr. Capano performed experiments designed to "investigate 2A asserted temperature and pressure conditions and to explain … the underlying physical principles active during growth under such conditions," Ex. 1 (Capano) ¶ 308:

> In order to assess the lower pressure growth conditions employed by 2A and their impact on surface temperature gradients and diamond growth, a diamond seed was exposed to conditions more closely matching those 2A uses in its commercial SCP diamond production, [redacted] …the experiment demonstrates uniform diamond growth and the lack of a temperature gradient exceeding 20 °C.

Id. ¶ 320.

66. Dr. Capano performed a Finite Element Analysis ("FEA"), modeling the heat transfer from the plasma to the diamond, focusing on uniform plasmas like 2A's, and concluded:

> [T]he information obtained from 2A regarding the uniformity of its process, the high thermal conductivity of diamonds, and the FEA discussed above, permit me to conclude that MPCVD diamond growth at 2A using the commercial SCP recipe and process does not occur outside the claimed limitation of a 20 °C temperature gradient.

Id. ¶ 210.

67. 2A has represented that its facility and equipment are [redacted]. Ex. 31 (May 6, 2020 Ltr. from Long to Fowler).

68. In his report, Dr. Nebel relies on testing conducted on a variety of IIA's samples. ECF No. 97-12 (Nebel Rep.) ¶¶ 307-321.

69. Dr. Nebel testified about his "temperature gradient test[s]" as follows:

> Q Okay, I understand that you've submitted -- our you conducted a bunch of temperature gradient testing on IIa's process; is that correct?
>
> A That is correct. Yes.
>
> Q Okay. Who ran those experiments for you?
>
> A I did -- I did talk to Mr. -- or Dr. Ghosh who is the head of the technical activities at IIa.

Q Mm-hmm.

A About the details of implementation.

Q Who designed the experiment?

A That was me.

Q Okay, and did you talk directly with Mr. Ghosh about the experiment.

A I never did talk to Mr. Ghosh directly. I mean there was always Mr. Long present.

Ex. 6 (Nebel 10/25/20 (Rough) Dep.) at 70:21-71:15.

Q Alright. how many conversations did you have with JP and Mr. Ghosh about these experiments?

A About the preparation of this experiment was one?

Q One. How often did you talk with JP and Mr. Ghosh during the actual running of the experiments?

A There was not too much conversation ongoing. I mean, it needed some time to practice these ideas, to test it.

Q Mm-hmm.

A And basically I had -- when I remember, not a second discussion about the about how they did it.

Id. at 124:7-21.

Q Okay, and who reported the results to you?

A That went about -- like always it was Mr. Long who got it and submitted it to me.

Id. at 126:14-17.

70. In his report, Dr. Nebel states that in order "[t]o understand the actual temperature gradients in 2AT's accused process, [he] directed a series of experiments conducted during 2AT's accused process." ECF No. 97-12 (Nebel Rep.) ¶ 307.

71. Dr. Nebel states that [redacted] and provides an example:

[redacted]

ECF No. 97-12 (Nebel Rep.) ¶ 311.

72. Dr. Nebel testified regarding the pyrometer's position during the tests:

> After the first few hours of growth, the growth surface becomes rough due to the growth process, and the pyrometer's laser spot becomes difficult to reliably capture with photographs. To ensure the position of each spot can be verified during the experiment, I therefore directed photographs to be taken of the pyrometer coordinates each time a new spot is measured. I also directed a spot position record to be maintained showing the coordinates and position on the growth surface. In addition, I asked that time-stamped video cameras monitor each machine throughout the [redacted] of experimentation.

ECF No. 97-12 (Nebel Rep.) ¶ 312.

73. Dr. Nebel states that "[i]f a temperature gradient exceeded 20º C., [he] asked that the data be captured":

> To assess whether all temperature gradients across the growth surface are less than 20º C., I asked that the pyrometer be used to scan the surface in accordance with the procedure specified by Drs. Hemley, Vohra, and Walter (discussed above). If a temperature gradient exceeded 20º C., I asked that the data be captured. For each spot measured, a photograph was taken to show the tilt coordinate, a photograph was taken to show the rotation coordinate, a spot position record was made to indicate the position of the spot on the growth surface, and the temperature data was captured in the growth log.

Id. ¶ 315.

74. Dr. Capano explained that in practicing the invention claimed in the ’078 patent, “a substrate holder that contacts the side of the growing diamond is not required to maintain a temperature gradient less than 20 °C”:

> [216.] In reaching my opinion that a substrate holder that contacts the side of the growing diamond is not required to maintain a temperature gradient less than 20 °C. I took into account of factors in addition to Dr. Vohra’s and Dr. Hemley’s indication that in their laboratory’s substrate holders in the form of a flat plate or surface were in use. I also weighed the fact that the research underlying the patent was conducted as part of a collaboration between two very busy major research laboratories in the field nearly about 20 years ago. In addition, I evaluated a variety of other evidence available to me including: the results of my own experiments, my FEA analysis, the proximity of the seeds and growing diamonds, the presence of growth between and at the periphery of the single crystal diamond being grown on the growth surface, and the results of the experiments I conducted.
>
> [217.] The experiments I conducted, such as Exp-3 described above, it was possible to control the temperature of the growth surface of diamond seeds such that all temperature gradients across the growth surface were less than 20 °C. None of those seeds was located in a holder making thermal contact with the sides of the diamond seed. It was also possible in that experiment to produce temper gradients in excess of 20 °C.
>
> [218.] The FEA analysis described above and in Appendix AA indicates that diamonds growing under conditions of temperature and pressure employed by 2A would not have a surface temperature gradient in excess of 20 °C at the growth surface even in the absence of a holder making thermal contact with the sides of the diamond. The FEA analysis, which was conducted without such a holder, supports those conclusions because in all cases, the heat flux variations needed to sustain temperature gradients of 20 °C or more are not compatible with growing uniform diamond epilayers. Moreover, even transient temperature gradients imposed on the

> growing diamond dissipated rapidly spreading the thermal energy across the diamond. Accordingly, the FEA indicates that neither a holder is necessary to limit the growth surface gradient to less than 20 °C, nor are the edge heating effect under conditions employed by 2A in its commercial SCP process sufficient to drive a temperature gradient in excess of 20 °C, particularly on diamonds growing in the middle, as opposed to at the edge of a plotted molly.

Ex. 1 (Capano) ¶¶ 216-218.

75. Dr. Gleason likewise explained that a side-contact substrate holder was not required to practice the invention claimed in the ’078 patent:

> The testimony of Dr. Vohra (cited at Nebel R. ¶198) does not establish that the asserted claims of the ’078 Patent *require* a side-contact substrate holder. That Dr. Vohra views the substrate holder design as important does not negate the disclosures of the patent regarding the numerous different ways in which the temperature of the growth surface can be controlled such as to maintain all temperature gradients at 20 °C or less. To the extent that Dr. Nebel is suggesting that it is not *possible* to meet the temperature gradient limitations of the asserted claims without a side-contact holder, the FEA performed by Dr. Capano (discussed above) confirmed that "a substrate holder that contacts the side of the growing diamond is not required to maintain a temperature gradient less than 20 °C." Capano R. at ¶220; *see also id.* at ¶¶196-223 & Appendix AA.
>
> Indeed, Dr. Nebel’s opinion acknowledges that there are many influences on the temperature of the diamond and the substrate holder that can be affected by varying parameters of the system (which are discussed in the patent). *See* ’078 Patent at 6:55-65. For example, Dr. Nebel opines that "diamond MPCVD involves many complex and interdependent electromagnetic, chemical, and thermal processes." Nebel R. at ¶203.

Ex. 2 (Gleason ’078) ¶¶ 197-198.

76. Dr. Hemley testified with regards to a "substrate holder" in the context of growing a single diamond:

> Q. So when you are growing a single diamond, you would have a -- the diamond -- strike that. When growing a single diamond, you would have the substrate holder directly contacting the side edges of the diamond; is that right?
>
> A. That was one version of it, yes.
>
> Q. Were there any versions that did not contact the sides of the diamond?

A. Pardon?

Q. Were there other versions that did not directly contact the sides of the diamond when you were growing one seed?

A. In some cases we wouldn't have material on the side.

Ex. 4 (Hemley 9/1/20 Dep.) at 56:8-22.

77. Dr. Hemley testified that "a flat molybdenum stage would provide suitable design for high-power growth on multiple seeds":

Q. So if I understand correctly, you are saying a flat molybdenum stage would provide suitable design for high-power growth on multiple seeds?

A. As I recall, that would work, again, depending on the thickness of the diamond that you want and the quality of the diamond you want.

Id. at 98:8-14.

78. The '078 patent discloses a method for growing a diamond with "a small degree of polycrystallinity localized at the top edges of the diamond." ECF No. 97-1 ('078 Patent) at 13:66-14:1.

79. IIA's position during claim construction was that the '078 patent required (1) measuring two different temperatures on the growth surface, and (2) using the measured temperatures for gradient control. ECF No. 46 (Opinion and Order) at 14-15.

80. The Court found that the claims "refer to 'all temperature gradients across the growth surface,' not merely those measured between the middle and the edge." ECF No. 46 (Opinion and Order) at 15.

81. The Court held that "controlling" should be defined "more broadly" to encompass not only the use of measured temperatures, but a number of "other inputs [that] are also 'used' to control the gradients." ECF No. 46 (Opinion and Order) at 16.

82. Dr. Capano testified that temperature "does not have to be directly measured," and 2A's CVD chambers "permit control of various other process parameters (e.g., microwave power …)—by adjusting those parameters, control over temperature can be achieved even though it is never measured." Ex. 1 (Capano) ¶ 327.

83. In its claim construction order, the Court recognized that in the beginning "the growth surface is the exterior surface of the diamond seed" which then shifts outward as "hydrocarbon gases accrue onto the seed to form new diamond." ECF No. 46 (Opinion and Order) at 18-19.

84. The Court construed the growth surface to mean "the surface upon which diamond growth is occurring" and made clear that the growth surface is "the entire surface where hydrocarbon gases are accruing into new diamond," including "localized places" that had "small amounts of polycrystalline diamond." *Id.* at 18-20.

85. [redacted]

[redacted]

[redacted] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

88. Dr. Nebel testified that he understands the term “growth surface” to include the entire surface of the molybdenum substrate holder (“Molly”), where (according to Dr. Nebel) diamond growth is occurring:

> A As soon there is a diamond, then the definition is given that the growth surface is the surface where diamond grows
>
> Q Okay, so, under your interpretation of the claim construction, anywhere where diamond grows, once the Molly is inserted into the chamber would constitute the growth surface?
>
> A Basically yes, the definition is wherever diamond is, then you have a growth surface and therefore the growth on the surface of diamond is adequate description.
>
> Q So your understanding the court’s construction of growth surface, the term diamond in that construction could be any type of diamond, not just single crystal diamond?
>
> A Yes, that is my understanding.

Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 20:25-21:17.

89. [redacted]

[redacted] [redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

92. [redacted]

[redacted]

[redacted]

[redacted]

93. Dr. Nebel testified that he did not perform any testing of the [redacted]

> Have you taken any of those blocks and tested them -- for examp–, have you tested to see what's the [redacted]
>
> A I did not apply more than visual inspection by my eye.
>
> Q Okay, so in your opinion all the [redacted] would be polycrystalline diamonds?
>
> A Indeed, that is my opinion, yes.
>
> Q But you did not test it to determine whether all of it was polycrystalline diamonds.
>
> A I did not characterize these blocks with respect help of sophisticated technical into ex to ^ identify what is going on here. Therefore, I use my eye and distinguish areas which are at least flat from areas which are typically rough by -- induced b–the polycrystalline structure.

Ex. 6 (Nebel (Rough) 10/26/20 Dep.) at 30:2-20.

94. Dr. Nebel did not perform any tests or experiments to determine what type of material [redacted]:

> Q But you didn't perform any of those tests to determine what type of material is [redacted] correct?
>
> A No, I did not do such experiments.
>
> Q So your opinion is solely based on your visual assessment of what's shown in exhibit 80 at page 23 that we're looking at in your exhibit or sorry, in your report?

> MR. SHARMA: Objection, form.
>
> BY THE WITNESS: I agree. I had no direct physical availability to this material, therefore, whatever I used is based on evaluation.

Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 32:1-12.

95. Despite having "no direct physical availability" to the material [redacted], Dr. Nebel disagrees with Dr. Misra's characterization of the [redacted]

Ex. 6 (Nebel 10/26/20 (Rough)Dep.) at 34:8-20.

3. Whether IIA infringes the claimed pressure and temperature limitations is disputed.

96. Dr. Capano applied the function, way, result test to determine that growing single crystal diamonds at a pressure of [redacted] is equivalent to growing them at a pressure of 130 torr. Ex. 1 (Capano) ¶¶ 250-62.

97. Dr. Capano found that 2A's process performs substantially the same function of "growing single crystal diamond" as recited in claim 1. Ex. 1 (Capano) ¶ 251; Ex. 33 (Carnegie_189_2AT-00158057-72) ¶¶ 190-200, 222-33; Ex. 34 (Carnegie_189_2AT-00158235-96) at ¶¶ 19, 29; Ex. 21 (Carnegie_189_2AT-00000286-92); Ex. 22 (Carnegie_189_2AT-00145993-95) at Carnegie_189_2AT_00145995; Ex. 23 (Carnegie_189_2AT-00131651-54); Ex. 19 (Mehta 8/3/20 Dep.) at 100:15-101:1; *Id.* (Mehta 8/4/20 Dep.) at 194:19-195:7, 218:22-19:5.

98. Dr. Capano found when going from a pressure of 130 torr to [redacted], the operators of 2A's system [redacted]. Ex. 1 (Capano) ¶ 252; Ex. 19 (Mehta 8/3/20 Dep.) at 50:16-54:7, 100:5-111:1; Ex. 7 (Misra 8/6/20 Dep.) at 35:23-42:23, 65:7-67:6, 69:6-11, 77:12-14, 86:16-90:1; Ex. 35 (Carnegie_189_2AT-00021242-23340) at Carnegie_189_2AT-00022648, 22782; Ex. 36 (Carnegie_189_2AT-00063465-4614) at Carnegie_189_2AT-00064291; Ex. 24 (CARN-PGD_163707-31) at CARN-PGD_163710-11;Ex. 37 (Carnegie_189_2AT-00157377); Ex. 38 (Carnegie_189_2AT-00145004-5039); Ex. 23 (Carnegie_189_2AT-00131651-54).

99. Dr. Capano found that to grow diamond at [redacted] instead of at 130 torr, 2A [redacted]. Ex. 1 (Capano) ¶ 253.

100. All other factors being constant, a pressure of 130 torr will result in a slightly [redacted] plasma ball than at a pressure of [redacted]. *Id.*; *see* Ex. 7 (Misra 8/6/20 Dep.) at 86:16-

90:1 ("If the pressure was higher, the size of the plasma will be smaller…[redacted].

101. To compensate for a [redacted] in pressure from 130 torr to [redacted], Dr. Capano determined that the operator need only [redacted] the size of the plasma ball. Ex. 1 (Capano) ¶ 253.

102. Dr. Capano found that making an adjustment in power to compensate for a difference of [redacted] would be minimal and insubstantial. *Id.*

103. 2A provides its operators [redacted]. Ex. 1 (Capano) ¶¶ 191, 253; *see also* Ex. 8 (Carnegie_189_2AT-00145742-544) at Carnegie_189_2AT-00154742-43 (Steps 1-4); Ex. 7 (Misra 8/6/2020 Dep.) at 104:2-106:18; Ex. 19 (Mehta 8/3/2020 Dep.) at 88:25-89:2; Ex. 19 (Mehta 8/4/2020 Dep.) at 147:4-8, 165:18-167:9; 209:3-212:4; *see also* Ex. 20 (Ghosh 8/25/20 Dep.) at 40:12-43:16.

104. Dr. Capano discusses a 2016 literature review that lists the various pressures at which different entities grew CVD diamonds. *See* Ex. 1 (Capano) ¶ 254 (discussing CARN-PGD_163707-31 (Ex. 24). Dr. Capano also performed experiments and examined 2A's documents and testimony from its witnesses, and concluded that processes using pressures of [redacted] and 130 torr achieve "substantially the same result." Ex. 1 (Capano) ¶¶ 255-261.

105. Dr. Capano also applied the function-way-result test to determine that growing diamonds at [redacted] is equivalent to growing diamonds at 900 °C. Ex. 1 (Capano) ¶¶ 279-302.

106. Dr. Capano found that 2A's process performs substantially the same function of "growing single crystal diamond" as recited in claim 12. *Id.* ¶ 280.

107. 2A grows single crystal diamond at a temperature of [redacted] °C. *Id.* ¶ 282. 2A controls the temperature of the deposition chamber so that it remains between [redacted] and preferably, between [redacted] *Id.*; *see also* Ex. 19 (Mehta 8/4/20 Dep.) at 207:20-22 ("the overall rule of being between [redacted] and not going beyond [redacted] That stands as a general rule."); Ex. 35 (Carnegie_189_2AT-00021242-23340) at Carnegie_189_2AT-00022782 [redacted] Ex. 36 (Carnegie_189_2AT-00063465-64614) at Carnegie_189_2AT-00064291 ([redacted]

108. [redacted]. Ex. 1 (Capano) ¶ 283; *see also* Ex. 19 (Mehta 8/4/20 Dep.) at 145:12-146:7.

109. [redacted] Ex. 1 (Capano) ¶¶ 285-86.

110. 2A need only make [redacted]. Ex. 1 (Capano) ¶ 287.

111. 2A's operators [redacted] Ex. 8

[redacted]

112. To [redacted] the temperature from 900 °C to [redacted] the operator [redacted] the [redacted]

113. 2A provides its operators with [redacted]. Ex. 1 (Capano) ¶¶ 191, 287.

114. An adjustment in power to compensate for a difference of [redacted] would be minimal and insubstantial. *Id.* ¶ 287 (discussing CARN-PGD_163707-31 (Ex. 24)).

115. Dr. Capano discusses a 2016 literature review that lists the various temperatures at which different entities grew CVD diamonds. *See id.* ¶ 288 (discussing CARN-PGD_163707-31 (Ex. 24)). Dr. Capano also examined results of 2A's own testing, as well as 2A's documents and testimony from its witnesses, and concluded that processes using temperatures of up [redacted] °C and 900 °C achieve "substantially the same result." Ex. 1 (Capano) ¶¶ 289-292.

116. [redacted]

[redacted].

4. **It is disputed whether IIA infringes under the DOE.**

117. None of the asserted claims recite, e.g., specific holder configurations, growth chemistries, or oxygen levels. ECF No. 97-1 ('078 patent) at Claims 1, 6, 12, 16, or 20.

5. **Plaintiffs are not precluded from asserting the DOE.**

118. The '078 patent claims recite control of the temperature of the growth surface such that the temperature gradients are less than 20° C. ECF No. 97-1 ('078 patent at claim 1, claim 12).

119. The '078 patent's specification, in the section titled "Background of the Invention," briefly discusses CVD and MPCVD processes:

> For at least the last twenty years, a process of producing small quantities of diamond by chemical vapor deposition (CVD) has been available. As reported by B. V. Spitsyn et al. in "Vapor Growth of Diamond on Diamond and Other Surfaces," Journal of Crystal Growth, vol. 52, pp. 219-226, the process involves CVD of diamond on a substrate by using a combination of methane, or another simple hydrocarbon gas, and hydrogen gas at reduced pressures and temperatures of 800-1200° C. The inclusion of hydrogen gas prevents the formation of graphite as the diamond nucleates and grows. Growth rates of up to 1 μm/hour have been reported with this technique.
>
> Subsequent work, for example, that of Kamo et al. as reported in "Diamond Synthesis from Gas Phase in Microwave Plasma," Journal of Crystal Growth, vol. 62, pp. 642-644, demonstrated the use of Microwave Plasma Chemical Vapor Deposition (MPCVD) to produce diamond at pressures of 1-8 Kpa in temperatures of 800-1000° C. with microwave power of 300-700 W at a frequency of 2.45 GHz. A concentration of 1-3% methane gas was used in the process of Kamo et al. Maximum growth rates of 3 μm/hour have been reported using this MPCVD process.

ECF No. 97-1 ('078 patent at 1:30-51)

120. The '078 patent's "Background of the Invention" section concludes by noting that "known processes for growing diamond usually require low pressures of less than 100 torr." *Id.* at 1:60-61.

6. Whether IIA infringes under 35 U.S.C. § 271(g) is disputed.

121. The '078 patent specification states that the diamond grown according to the claimed process may be annealed to change the color. ECF No. 97-1 ('078 Patent 14:40-42 ("The colors of diamond formed by the methods discussed above [can] be changed by annealing. For example, a yellow [or] brown diamond can be annealed into a green diamond.")); Ex. 25 (De Weerdt 10/19/20 Dep.) at 91-19-92:5 ("Q. So you would agree … that even the inventors of the '078 patent … knew that annealing was a step that could be applied after the diamond was grown in order to change its color, right? A. Yes, because they wrote it in the '078 patent. Q. And that annealing would refer to the same high pressure high temperature treatments that we've been talking about today, right? A. Yes, because it's written like that in the patent. In the '078 patent, I'm sorry.")); ECF No. 97-39 (De Weerdt Rebuttal Rep.) ¶ 74.

122. The specification of the '078 patent incorporates by reference a paper by the inventors entitled "Very High Growth Rate Chemical Vapor Deposition of Single-Crystal Diamond," Proceedings of the National Academy of Sciences, Oct. 1. 2002, volume 99, no. 20, pages 12523-12525 ("Yan"). ECF No. 97-1 _('078 Patent) 14:44-49; ECF No. 97-39 (De Weerdt Rebuttal Rep.) ¶ 74.

123. Yan reported that "[o]ne promising technique is to use HPHT treatment to fix and enhance cracked, brownish MPCVD diamond to produce colorless material." ECF No. 97-3 (Yan) at 12525; Ex. __ (De Weerdt 10/19/20 Dep.) at 92:22-93:3 ("Q. So you would agree that Yan, the reference that was incorporated into the '078 patent, also described HPHT annealing as

a typical post-processing step for lab grown diamonds in order to provide color enhancement, right? A. Yes, indeed.")); ECF No. 97-39 (De Weerdt Rebuttal Rep.) ¶ 74.

124. Annealing does not change a diamond's carat, hardness, shape, or size. Ex. 39 (Capano (Rough) Dep.) at 260:24-261:7.

125. Subjecting a diamond to the annealing process of the '189 Patent still results in a diamond. Ex. 39 (Capano (Rough) Dep.) at 242:11-23 ("The material itself doesn't change. A property of the material is different because of an atomic level of change in the arrangement of atoms, but the diamond is still a diamond. … So if you take diamond out of the ground and you perform a process on it so that you are cutting and possibly annealing it, it is still a diamond. So there is no -- I wouldn't call it a material change.").

126. Subjecting CVD diamonds to the annealing process of the '189 Patent does not materially change the diamond. Ex. 39 (Capano (Rough) Dep.) at 18:17-24 ("Q. For the '189 were you able to understand the changes to the diamond that were being described through the annealing process? A. The changes in the annealing process are really not that significant. I wouldn't describe them as a material change as much as I would describe what is happening during the anneal as a rearrangement of atoms from position to position."); *id*. 242:11-23 ("The material itself doesn't change. A property of the material is different because of an atomic level of change in the arrangement of atoms, but the diamond is still a diamond…. So if you take diamond out of the ground and you perform a process on it so that you are cutting and possibly annealing it, it is still a diamond. So there is no -- I wouldn't call it a material change.").

127. Annealing a diamond by the process described in the '189 patent will still result in a diamond. Ex. 25 (De Weerdt 10/19/20 Dep.) at 59:20-60:9 ("Q. [I]f I started with a diamond and performed the type of processing recited in the claims of the '189 patent, could I end with

something that is not a diamond? [Objection omitted] A. You will have something that is maybe a small layer of graphite, but it will be, for most part, a diamond. Q. And that's because the repeating arrangement of carbon atoms that we started with, because we started with a diamond, is still present in the resulting diamond, right? A. Yes, that is correct.").

128. Dr. De Weerdt testified that 2AT's annealing process does not cause nitrogen impurities to be removed. Ex. 25 (De Weerdt 10/19/20 Dep.) at 69:4-70:18.

129. Dr. De Weerdt could not confirm whether 2A's annealing process improves the shade, thermal conductivity, or electrical resistance of 2A's CVD diamonds. Ex. 25 (De Weerdt 10/19/20 Dep.) at 70:19-72:16; *see also id.* at 73:21-75:2, 77:9-78:1.

130. Dr. De Weerdt opines that "[i]n materials science, 'annealing' generally refers to a heat treatment that significantly alters the physical and sometimes chemical properties of a material to improve its properties," using the example that "annealing is used to harden steel." ECF No. 97-39 (De Weerdt Rebuttal Rep.) ¶¶ 50-51.

B. Whether the Asserted Claims of the '078 Patent are Invalid is Disputed.

1. There are disputed issues of fact as to enablement.

131. The asserted claims of the '078 patent do not recite a substrate holder or a specific configuration of a substrate holder. Ex. 2 (Gleason '078) ¶¶ 102-03, 130, 133-36, 208-09; ECF No. 97-1 ('078 patent) at claims 1, 6, 12, 16, & 20 (reciting the claim elements).

132. The asserted independent claims of the '078 patent (claims 1 and 12) recite, *inter alia*, "controlling temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C." ECF No. 97-1 ('078 patent) at Claims 1, 12 (reciting the claim elements).

133. The '078 patent provides that one mode of practicing "controlling [the] temperature of a growth surface of the diamond such that all temperature gradients across the

growth surface are less than 20° C" involves using a substrate holder that makes thermal contact with the side surfaces of the diamond. Ex. 2 (Gleason '078) ¶¶ 102-03, 130, 133-34, 138-40, 208-09; ECF No. 97-1 ('078 patent) at 2:12-18.

134. The patent specification also provides a specific example of a substrate holder that, with only minor modifications, would not make thermal contact with the side surfaces. Ex. 2 (Gleason '078) ¶¶ 130-52; ECF No. 97-1 ('078 patent) at 7:5-10 (discussing Figure 2b).

135. The '078 patent's Figure 2b ("a perspective view of the diamond" and sheath shown in Figure 1) shows diamond 136 in relation to sheath 134. ECF No. 97-1 ('078 patent) at 7:5-6. The figure further depicts "the distance D between the growth surface 137 or top edges 139 of the diamond 136 and an edge 135 of the sheath 134." Ex. 2 (Gleason '078) ¶ 139; ECF No. 97-1 ('078 patent) at 7:8-10.

136. A person of ordinary skill in the art would understand that the diamond in the embodiment in Figure 2b can be positioned above the sheath (134), which indicates to a person of skill in the art that a flat plate could easily replace the stage/holder with a sheath. In that instance, the "sheath," as a flat plate, would touch each of the four side surfaces of the diamond only along the four bottom edges. Ex. 2 (Gleason '078) ¶¶ 139-40.

137. A person of ordinary skill in the art would recognize that a substitution of the sheath in '078 patent Figure 2b with a flat plate could be made because of the exceptionally high heat conductance of diamond which directs the thermal energy in the diamond essentially directly downward to the cooling substrate. Ex. 2 (Gleason '078) ¶ 141.

138. Prior to the filing of the '078 patent, flat plates had previously been used to hold diamond seeds in MPCVD systems. Ex. 2 (Gleason '078) ¶¶ 145-48.

139. A 1994 article (Jubber) discusses an MPCVD system in which "[s]ubstrates are heated on a molybdenum support on top of the platen." Ex. 26 (Jubber) at 501; Ex. 2 (Gleason '078) ¶ 145. Jubber illustrates a design in which the substrate is simply sitting atop a flat holder. Ex. 26 (Jubber) at Figure 2; Ex. 2 (Gleason '078) ¶ 145.

140. U.S. Patent No. 5,311,103 to Asmussen discloses the use of a flat substrate holder ("susceptor 51" in Figures 1-2). Ex. 27 (Asmussen) at 8:27-28, 9:11, Figs. 1-2; Ex. 2 (Gleason '078) ¶ 146.

141. The Saito reference also discloses a flat holder ("base material holder 1" in Figure 10). Ex. 28 (Saito) at 8:42, Fig.10; Ex. 2 (Gleason '078) ¶ 147.

142. Dr. Nebel agreed that flat plate holders were known in the 1990s and known to be used with MPCVD systems. Ex. 6 (Nebel 10/25/20 (Rough) Dep.) at 52:23-53:1 (Q. "Were flatted or open substrate holders known in the 1990s to be used with MPCVD systems? A The closed substrate holder came much later on …); *id* at 53:24-55:2 (e.g., "So the earliest MPCVD systems started out with a flat holder and since then development has occurred on the substrate holder away from flat and open substrate holders. … A. That appears to me to be the history of the published diamond holders used in the time 1990 to 1999, 2000 …"). A flat plate holder is also similar to the embodiment shown in Figure 3 of the '078 Patent, which also shows the grown diamond portion (reference number 140) of the diamond (reference number 136) having sides that are exposed to the plasma (reference number 341). Ex. 2 (Gleason '078) ¶ 149; ECF No. 97-1 ('078 patent) at Fig. 3.

143. Provisional Application for the '078 Patent, Prov. No. 60/331,073 shows at least some exposure of the side surfaces of the diamond. Ex. 2 (Gleason '078) ¶ 150; Ex. 29 (Provisional Application No. 60/331,073) at Fig. 2.

144. In addition to the physical design of the substrate holder, the interactions of that holder with the CVD process conditions described in the '078 patent determine the rate and quality of the deposited diamond. Ex. 2 (Gleason '078) ¶ 152.

145. Implementing a known flat plate configuration in the '078 patent method would be routine for a skilled artisan and would not require undue experimentation. Ex. 2 (Gleason '078) ¶¶ 138-52, 204-05, 208, 214-15.

146. Christoph E. Nebel, IIA's expert in this case, is listed as the first-named inventor on United States Patent No. 10,100,433 (the "Nebel '433 Patent"), titled "Substrate Holder, Plasma Reactor and Method for Depositing Diamond," which was filed on November 10, 2015 and issued on October 16, 2018. Ex. 40 (Nebel '433 Patent) at cover; *see also* Ex. 6 (Nebel 10/26/20 (Rough) Dep. at 108:3-25.

147. The background section of the Nebel '433 Patent refers to WO 2003/040440 A2, which it describes as a "known method." Ex. 40 (Nebel '433 Patent) at 1:19-20.

148. WO 2003/040440 A2, titled "Apparatus and Method for Diamond Production, corresponds to PCT/US2002/035659 and lists Russell J. Hemley, Ho-kwang Mao, Chih-shiue Yan, and Yogesh K. Vohra as inventors. Ex. 30 (WO 2003/040440 A2) at cover.

149. WO 2003/040440 A2 is the international application corresponding to the '078 patent. *Compare id. with* ECF No. 97-1 ('078 Patent); *see also* Ex. 41 (Nebel Opening Report) ¶¶ 277, 282, 305, 335, 362 (relying on the "EPO Opinion," defined on page "v" as "Patent Cooperation Treaty Written Opinion, International Patent Application No. PCT/US02/35659" in discussing the disclosures of the '078 patent); Ex. 6 (Nebel 10/26/20 (Rough) Dep. at 109:8-110:1.

150. The Nebel '433 Patent states that:

> Such a method is known from WO 2003/040440 A2. In this known method, a monocrystalline diamond is arranged as a substrate on the base plate of a substrate holder and heated to a temperature of above 900° C. by means of an assigned heating device. Plasma containing hydrogen, nitrogen and methane is ignited above the surface of the substrate. A diamond layer is subsequently deposited on the substrate at a growth rate of 1 to 3 μm/h. The diamond layer deposited from the gas phase grows with the crystal direction predetermined by the substrate, and therefore it is also possible to deposit a monocrystalline diamond layer in the case of a substrate from monocrystalline diamond.

Ex. 40 (Nebel ’433 Patent) at 1:19-30.

151. The Nebel ’433 Patent describes WO 2003/040440 A2 as teaching a substrate holder with a base plate, and does not describe such substrate holder as limited to one making thermal contact with the side surfaces of the diamond. *See id.*; *see also* Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 118:16-23.

152. Dr. Nebel admitted in deposition that the Nebel ’433 Patent describes the international application corresponding to the ’078 patent, but does not describe “side walls” as a component of the substrate holder. Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 110-11; *id.* at 118 (“Please tell me ‘yes’ or ‘no’ does the word ‘Side walls’ appear in the sentence this in known method, a mono crystalline diamond is arranged as a substrate on the base plate of a substrate holder and heated to a temperature of 900-degree C, ‘yes’ or ‘no’? A The. The side walls is not coming up here.”).

153. The Nebel ’433 Patent describes WO 2003/040440 A2 as including temperatures above 900 °C (which would include temperatures between 900-1000 °C) without reference to oxygen. Ex. 40 (Nebel ’433 Patent) at 1:19-30.

154. Referring to the method of WO 2003/040440 A2, the Nebel ’433 Patent further states that:

> However, this known method has the drawback that individual substrates from monocrystalline diamond only have a small size. In order to efficiently

> carry out the method, the base plate of the substrate holder can be equipped with a plurality of substrates which can be coated at the same time. However, the drawback is that these individual substrates are then interconnected by a polycrystalline diamond layer deposited from the gas phase. Thereafter, the individual substrates must be separated upon conclusion of the growth process, e.g. by being removed using the laser cutting method. This damages the substrate holder, and therefore a new substrate holder always has to be provided for the repeated conduction of the method.

Id. 1:31-43.

155. The Nebel '433 Patent describes WO 2003/040440 as having as a drawback when using multiple seeds that the individual substrates are interconnected by a polycrystalline diamond layer that must be separated. *See id.*; *see also* Ex. 6 (Nebel 10/26/20 (Rough) Dep.) at 119:1-8, 125:16-127:1.

156. In the '078 patent, the position of the substrate holder in relationship to the side surfaces of the diamond is one of a number of factors identified by the specification as impacting the ability to "control[] the temperatures of the growth surface such that all the temperature gradients across the growth surface of the diamond are less than or equal to 20° C." ECF No. 97-1 ('078 patent) at 6:48-51; Ex. 2 (Gleason '078) ¶¶ 153-93.

157. A person of ordinary skill in the art would have understood at the time the '078 patent was filed how to use the various factors detailed in the patent regardless of whether the holder makes thermal contact with the side surfaces. Ex. 2 (Gleason '078 Rep.) ¶¶ 195, 198, 201, 206, 209, 211-12, 215-17, 218-20, 222.

158. A POSA would have understood that the inventors were in possession of using these combined factors to achieve the claimed temperature gradients. Ex. 2 (Gleason '078 Rep.) ¶¶ 88, 194-201.

159. It was within routine knowledge of a person of ordinary skill in the art to at the time of the invention to adjust the factors identified by the specification as impacting the ability

to "control[] [the] temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C." Ex. 2 (Gleason '078 Rep.) ¶¶ 195, 198, 201, 206, 209, 211-12, 215-17, 218-20, 222.

160. ECF No. 97-28 (Ex. 29 to the Long Decl.) is titled "Huron Capital Lender Presentation." ECF No. 97-28 at CARN-PGD_00115739. It is dated November 7, 2018. *See id.*

161. ECF No. 97-28 was prepared to provide high-level information to potential lenders. Ex. 42 (Tsach Dep.) at 163:9-165:2; ECF No. 97-28.

162. ECF No. 97-28 includes [redacted]. ECF No. 97-28 at CARN-PGD_00115744-46. [redacted] *Id.* at CARN-PGD_00115744. ECF No. 97-28 does not address whether the patent enables a person of ordinary skill in the art at the time to "control[] [the] temperature…such that all temperature gradients across the growth surface are less than 20° C." *See generally id.* at CARN-PGD_00115744-46.

163. ECF No. 97-28 notes additional know-how related to laboratory grown diamonds. *See id.* This additional work is related to scaling up the process claimed in the '078 patent commercial diamond production. *See* ECF No. 97-28 at CARN-PGD_00115744-46; *see also* Ex. 2 (Gleason '078) ¶¶ 81, 292. [redacted]. *See* ECF No. 97-28 at CARN-PGD_00115746.

164. A person of ordinary skill in the art could practice the invention claimed in the '078 patent without the additional research described in ECF No. 97-20. Ex. 2 (Gleason '078) ¶¶ 81, 292.

165. In 2010, Applied Nanocarbon advised Carnegie that it could not produce a diamond that was "commercially" viability and "colorless." ECF No. 97-35 at CARN-PGD_00227876.

166. In 2011, Carnegie and Washing Diamond entered a license agreement that included a license to the '078 patent. ECF No. 97-37.

167. In 2012, Washington Diamond successfully grew its first diamond. ECF No. 97-36 at CARN-FEN_00135714.

168. In 2013, Washington Diamond sold its first diamond. ECF No. 97-36 at CARN-FEN_00135714.

2. There are disputed issues of fact as to lack of written description.

169. The '078 patent specification repeatedly describes "controlling the temperature of a growth surface of the diamond such that all temperature gradients across the growth surface are less than 20° C.," and provides a POSA substantive means by which to practice this limitation. Ex. 2 (Gleason '078) ¶¶ 88, 153-201.

170. At times, the '078 patent specification describes the use of a substrate holder that makes thermal contact with the side surfaces of the diamond. Ex. 2 (Gleason '078) ¶¶ 88; ECF No. 97-1 ('078 patent) at 2:12-24. In other instances, the '078 patent describes the invention claimed with no reference to thermal contact between the substrate holder and the side surfaces of the diamond. Ex.2 (Gleason '078) ¶¶ 88; ECF No. 97-1 ('078 patent) at 2:25-3:13, 6:48-7:23, 11:12-31, 12:21-46.

171. A person of ordinary skill in the art reading the '078 patent specification would understand that the inventor possessed methods both with and without thermal contact between the substrate holder and side surfaces. Ex. 2 (Gleason '078) ¶¶ 88, 130-152, 194-201; ECF No. 97-1 ('078 patent) at 2:25-3:13, 6:48-7:23, 11:12-31, 12:21-46.

3. It is disputed whether low temperatures are adequately described.

172. The asserted claims of the ’078 patent do not recite a required oxygen composition. ECF No. 97-1 (’078 patent) at claims 1, 6, 12, 16, 20; Ex 2 (Gleason ’078) ¶ 340.

173. Claim 12 of the ’078 patent recite a temperature range: 900-1400° C. ECF No. 97-1 (’078 patent) at Claim 12.

174. The ’078 patent specification describes a temperature range of “about 900-1400° C”: “temperature may be selected from a range of **about 900-1400° C**.” ECF No. 97-1 (’078 patent) at 13:19-27 (emphasis added); Ex. 2 (Gleason ’078) ¶ 337.

175. Example 2 of the ’078 patent describes that “[a] high-quality, pure CVD single crystal diamond … was created … by adding a small amount (1-3%) of oxygen and lowering the growth temperature to **900 degrees Celsius**.” ECF No. 97-1 (’078 patent) at 14:30-34 (emphasis added); Ex. 2 (Gleason ’078) ¶ 338.

176. Table 1 in the patent lists the results from the process used in one example of the claimed process (described in Example 1). ECF No. 97-1 (’078 patent) at 14:15-26. A person of ordinary skill in the art reviewing the specification of the ’078 patent would not understand the results reported in Table 1 would be achieved under different process conditions. Ex. 2 (Gleason ’078) ¶ 341; Ex. 42 (Bachmann-1) at 65; Ex. 43 (Wild) at 375-77; Ex. 44 (Müller-Sebert) at 759-60.

177. A person of ordinary skill reviewing the specification would understand that, while oxygen was added to achieve increased growth at a lower temperature, this does not mean that the only way to grow diamond at the low end of the range is by use of oxygen. Ex. 2 (Gleason ’078) ¶ 343.

178. Dr. Hemley testified that the ’078 patent does not “rule out” using a temperature below 1000° with a gas chemistry other than that used in Example 1. Ex. 4 (Hemley 9/1/20 Dep.) at 137:12-138:2.

179. Mr. Tsach testified that he did not think “the temperature range depends on the gas chemistry,” but rather that the patent taught “that both the gas chemistry and the temperature needs to be maintained in certain ranges in order to achieve a diamond growth.” Ex. 42 (Tsach Dep.) at 192:7-12.

180. The prior art Hemawan & Hemley-1 reference explained that diamond growth was achieved “in the temperature range of 820-950ºC.” Ex. 2 (Gleason ’078) ¶ 344; Ex. 46 (Hemawan & Hemley-1) at 812.

181. A person of ordinary skill in the art would have understood the specification to adequately describe the growth of single-crystal diamond by microwave plasma chemical vapor deposition on the growth surface at a temperature of 900-1400° C. Ex. 2 (Gleason ’078) ¶ 345.

182. A person of ordinary skill in the art reviewing the ’078 patent specification would have understood how and whether to adjust the gas mixture to account for temperature. Ex. 2 (Gleason ’078) ¶¶ 341-43; Ex. 43 (Bachmann-1) at 65; Ex. 44 (Wild) at 375-77; Ex. 45 (Müller-Sebert) at 759-60.

183. Claims 4 and 7 of the ’078 patent do not depend for independent Claim 12. ECF No. 97-1 (’078 patent) at claims 4, 7, 12.

C. Whether the Asserted Claims of the ’189 Patent Are Indefinite Is Disputed.

184. Claim 1 of the ’189 patent reads:

> 1. A method to improve the optical clarity of CVD diamond where the CVD diamond is single crystal CVD diamond, by raising the CVD diamond to a set temperature of at least 1500° C. and a pressure of at least 4.0 GPA outside of the diamond stable phase.

ECF No. 97-38 ('189 patent), Claim 1.

185. Dr. Gleason opined on a POSA's understanding of the phrase "outside of the diamond-stable phase" at the time of the '189 patent application:

> A person of ordinary skill in the art, at the time the application for the '189 patent was filed, would understand the meaning of "outside of the diamond-stable phase," would have resources available to determine (within the uncertainty permitted in the field of chemistry) what conditions are outside of the diamond-stable phase, and would be able to ascertain the scope of the claims. Skilled artisans would not be at an utter loss to interpret the meaning of that term.

Ex. 3 (Gleason '189) ¶ 210.

186. Dr. Gleason further noted:

> As Dr. De Weerdt notes, the carbon phase diagram had been published by several researchers, including Bundy in 1996 (*Bundy* at Fig. 1). The uncertainty surrounding the precise placement of the phase boundaries would not trouble a person of skill in the art. Theoretical boundaries like this this always carry uncertainty, particularly at conditions that are difficult to replicate in real life. A skilled artisan would survey the available literature and make a well-informed determination of the phase boundary and would ascertain within the uncertainty permitted in chemistry whether a particular condition was inside or outside the diamond-stable phase.

Id. ¶ 211.

187. The boundary line between the diamond and graphite phases of carbon was the subject of several scientific studies. *See* Ex. 1(Capano) ¶¶ 380-84; ECF No. 97-53 (Berman-Simon); ECF Nos. 97-49, 97-50 (Bundy); Ex. 10 (Vagarli); Ex. 11 (Strong 380); ECF Nos. 97-55, 97-56 (Day); ECF No. 97-52 (Kennedy & Kennedy); ECF No. 97-51 (Strong 690).

188. There is no imprecision surrounding the scientific definition of the boundary line. The "uncertainty" in the literature is in the thermodynamic and experimental data used to estimate the boundary, leading to some scientific disagreement around the value of certain thermodynamic parameters establishing the boundary line. ECF No. 97-56 (Day) at 59-60.

189. Dr. Capano determined the "delineation line between graphite and diamond stable phase" based on his review of six references:

> [381.] I have reviewed each of the references in the table below to gather an understanding of the analysis in each of the papers. Based on my review of each of the papers and publications listed in the table below, I have determined the slope of the delineation line between the graphite and diamond stable phase for each of the references. Those equations are also in the table below. I have provided the formulas or equations for the temperature in each of kelvin and centigrade as some of the references use kelvin and others use centigrade.
>
> [382.] As shown in the table below, the slope and y intercept for the equation for the Bundy reference is lower than those in each of the other references. This means, that of the references that I reviewed the Bundy reference has the lowest associated pressure with a given temperature for the delineation between the graphite and diamond stable phase.

Reference	**Bates number**	**Formula P (GPa) and T in Kelvin**	**Formula** P (GPa) and T in °C
Berman - Simon	CARN-PGD_00163519-524	P = (0.027 · T + 7.1)/10	P = (0.027 · T + 14.47)/10
Bundy et al.	Misra Ex. 52.	P = (0.020 · T+20)/10	
US Pat. Pub. No.: 2001/0031237 Al (Vagarali et al.)	Carnegie_189_Defendants-00000815-0823	P = (0.025 · T + 12.6)/10	P = (0.025 · T + 19.4)/10
US Pat. No. 4,174,380 (Strong)	Carnegie_189_Defendants-00000695-706	Data taken from plot	
K&K preferred line from Day (see Table 1)	CARN-PGD_00163501-511	P = (0.025 · (T - 273) + 19.4)/10	P = (0.025 · T + 19.4)/10
G&K corrected line from Day (see Table 1, Eq. 4)	CARN-PGD_00163501-511	P = (0.027 · (T - 273) + 16.5)/10.	P = (0.027 · T + 16.5)/10.

Ex. 1 (Capano) ¶¶ 381-82.

190. In the context of discussing the term "diamond stable phase," Dr. Gleason stated:

> The uncertainty surrounding the precise placement of the phase boundaries would not trouble a person of skill in the art. Theoretical boundaries like this this always carry uncertainty, particularly at conditions that are difficult to replicate in real life. A skilled artisan would survey the available literature and make a well-informed determination of the phase boundary and would ascertain within the uncertainty permitted in chemistry whether a particular condition was inside or outside the diamond-stable phase.

Ex. 3 (Gleason '189) ¶ 211.

191. Dr. Hemley testified:

> Q. Okay. So this is the Bundy paper, 1996.
> And this R. J. Hemley is you; right?
> A. Yes.
> Q. And you were a coauthor on this?
> A. Yes.
> Q. The first sentence in the abstract says, "In recent years, important advances in our understanding of the pressure-temperature phase and transformation diagram for carbon have occurred as a result of developments in both experimental and theoretical techniques." Do you see that?
> **A. Yes.**
> Q. Is that true?
> **A. Yes.**
> Q. It also says here in the abstract, "This paper focuses primarily on developments since the last review of the carbon phase diagram published in 1989, but also includes references to the older reliable work." Do you see that?
> **A. Yes.**
> Q. Do you see here in the first column it says, "The plan for this article is to present the entire phase diagram as we currently understand it and then discuss each part giving the salient references and brief descriptions of the work upon which it is" -- Excuse me. Let me start over.
> It says, "The plan for this article is to present the entire phase diagram as we currently understand it and then discuss each part giving the salient references and brief descriptions of the work upon which it is based." Do you see that?
> A. Yes. Q. Is that what this article does?
> A. Mm-hmm.
> Q. Figure 1 says this is a "P,T" -- I assume that means pressure and temperature -- "phase and transition diagram for carbon as understood from experimental observations through 1994"; is that correct?
> A. Yes.

> Q. And in the text here on the same page
> under "The Phase and Reaction Diagram," it says,
> "The topology of stability fields of the
> thermodynamically stable phases is quite simple:
> (i) the boundary between the graphite and diamond
> stable regions which runs from 1.7 GPa/0 K, to
> the graphite/diamond/liquid triple point at about
> 12GPa/5000K." Is that referring to this line
> here?
> A. Yes.
> Q. Between 5,000 and zero?
> A. Yes, yes.
> Q. Is that the transition between the diamond
> and graphite stable regions of the phase diagram?
> A. That defines the thermodynamic boundary
> between graphite and diamond.

Ex. 4 (Hemley 9/1/20 Dep.) at 166:16-168:24.

192. Mr. Tsach testified:

> 7 Again, I do not know why not. To me the
> 8 understanding of what the sentence of outside of
> 9 diamond stable phase is -- has ambiguity in it. So
> 10 I don't know how to answer why not.
> 11 Q. What's ambiguous about being outside the
> 12 diamond stable phase?
> 13 A. The phase diagram that is defining
> 14 thermodynamically the transition between graphite
> 15 and diamond by itself is described differently by
> 16 different people, and also by itself is -- there is
> 17 a question whether this phase diagram
> 18 thermodynamically describes the process that is
> 19 actually happening. So the definition of outside
> 20 the diamond stable phase is a question of its own.
> 21 Q. A question of what?
> 22 A. Of its own. There is -- there is a
> 1 discussion around what does this mean.

Ex. 42 (Tsach Dep.) at 227:7-228:1

193. Dr. Walter testified with regards to published phase diagrams: “There have been a number of determinations of the graphite to diamond stable region over the years. They’re all within -- they’re all pretty close to each other. …So each of those approaches to determining that

phase boundary will have uncertainties associated with it, and so that particular location, this particular line that's not drawn on this diagram, might shift from publication to publication to some slight degree….It has changed to some degree, but not significantly." ECF No. 97-54 at 205:19-22, 206:12-17, 208:12-13.

D. It is Disputed Whether the Asserted Claims of '189 Patent Are Infringed.

194. In his opening report, Dr. De Weerdt cites F.P. Bundy et al., *The Pressure-Temperature Phase and Transformation Diagram for Carbon; Updated Through 1994*, 34 CARBON 141 (1996) ("*Bundy*"). Ex. 47 (Initial Expert Report of Dr. Filip De Weerdt Regarding the Invalidity of Claims 1 and 2 of U.S. Patent No. RE41,189) ("De Weerdt Op. Rep.") at iii.

195. In his opening report, Dr. De Weerdt cites U.S. Patent Application Pub. No. 2005/0260935 A1 to Anthony et al. ("*Anthony-4*"). *Id.* at v.

196. In his opening report, Dr. De Weerdt cites U.S. Patent Application Pub. No. 2001/0031237 to Vagarali et al. ("*Vagarali-1*"). *Id.* at iii.

197. In his opening report, Dr. De Weerdt states:

> For temperatures and pressures in the shaded region highlighted in the figure above, the '189 Patent does not provide any way for a person of ordinary skill in the art to discern whether those conditions are within the diamond-stable or graphite-stable region of the carbon phase diagram. Although the 1996 Bundy article was the most up-to-date and reliable authority at the time the application for the '189 Patent was filed, *Anthony-4* and *Vagarali-1* both suggest that other definitions, like the one provided in the 1976 Kennedy & Kennedy study, also still persisted at the time, leading to competing standards.

Id. ¶ 269.

198. Dr. Capano determined that "at least some of the CVD diamonds annealed by 2A [are] single crystal CVD diamond." Ex. 1 (Capano) ¶¶ 368-72.

199. Dr. Capano reviewed each of the following references and thereafter "determined the slope of the delineation line between the graphite and diamond stable phase for each of the references":

Reference	Bates number	Formula P (GPa) and T in Kelvin	Formula P (GPa) and T in °C
Berman - Simon	CARN-PGD_00163519-524	P = (0.027 · T + 7.1)/10	P = (0.027 · T + 14.47)/10
Bundy et al.	Misra Ex. 52.	P = (0.020 · T+20)/10	
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G&K corrected line from Day (see Table 1, Eq. 4)	CARN-PGD_00163501-511	P = (0.027 · (T - 273) + 16.5)/10.	P = (0.027 · T + 16.5)/10.

Ex. 1 (Capano) ¶ 382.

200. Based on his analysis, Dr. Capano determined that the specific pressures and temperatures used in 2A's annealing process fall within the '189 patent's claims. *Id.* ¶¶ 373-400.

201. Dr. Capano was also able to determine that diamonds annealed by 2A are annealed within the graphite stable phase (i.e., outside the diamond stable phase). *Id.* ¶¶ 387-91.

202. Dr. Capano ultimately determined that 2A's annealing processes infringe the asserted claims. *Id.* ¶¶ 373-402.

203. Regarding the carbon phase diagrams in the scientific literature, Dr. Walter testified that "there's no gold standard" and researchers "look at each of the individual determinations in detail to make an assertion about how much you -- how much uncertainty were involved in those experiments." ECF No. 97-54 at 207:1-7.

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Respectfully submitted,

PERKINS COIE LLP

*<u>/s/ Matthew J. Moffa</u>*__________________
Matthew J. Moffa
PERKINS COIE LLP
1155 Avenue of the Americas
22nd Floor
New York, NY 10036-2711
Telephone: (212) 261-6857
Fax: (212) 399-8057
e-mail: MMoffa@perkinscoie.com

Terrence J. Wikberg (*admitted pro hac vice*)
Michael A. Chajon (*admitted pro hac vice*)
PERKINS COIE LLP
607 14th Street, NW
Washington, DC 20005
Telephone (202) 434-1649
Fax: (202) 654-9149
e-mail: TWikberg@perkinscoie.com
MChajon@perkinscoie.com

Amy E. Simpson (*admitted pro hac vice*)
Kevin Patariu
PERKINS COIE LLP
11452 El Camino Real, Suite 300
San Diego, CA 92130-3334
Telephone: (858) 720-5702
Fax: (858) 720-5799
e-mail: ASimpson@perkinscoie.com
KPatariu@perkinscoie.com

Michelle Umberger (*admitted pro hac vice*)
PERKINS COIE LLP
33 East Main Street, Suite 201
Madison, WI 53703-3095
Telephone: (608) 663-7466
Fax: (608) 663-7499
e-mail: MUmberger@perkinscoie.com

Sarah Fowler (*admitted pro hac vice*)
PERKINS COIE LLP
3150 Porter Drive
Palo Alto, CA 943041212
Telephone: (650) 838-4489

e-mail: SFowler@perkinscoie.com

Counsel for Plaintiffs Carnegie Institution of Washington and M7D Corporation